AMENDMENTS TO THE SPECIFICATION:

Please delete the paragraphs beginning at page 8, line 1 and ending at page 10, line 27.

Please insert the following paragraphs (which correspond exactly to the above deleted paragraphs) at page 12, after line 26.

--The apparatus is specially designed to ensure that the cylinder is held in place with respect to the ultrasonic sensor while it is being spun. Rubber rollers will not typically work with a full immersion system, as the cylinder will typically float, eliminating the frictional force required to spin the cylinder. According to the present invention, the cylinder is captured between two centering fixtures and then spun. The centering fixtures consist of a cup and a cap, e.g., as set forth in **Figure 3**. The cup consists of an interchangeable centering ring made of UHMW polyethylene or a similar material, mounted in an aluminum (or comparable material) outer ring. The centering ring is tapered to accept various diameter cylinders. A completed tailstock combines with the cap and output shaft to allow the cylinder or other container to self-center. The cylinder is axially clamped, e.g., using a pneumatic cylinder. The cap is made of aluminum with a machined groove that can accept a rubber collar. The cap has tapered edges on both the OD and ID that are staggered above and below the groove. A compliant collar is inserted into the groove and extends beyond the tapered edge of the cap. This allows the collar to deform in a particular way. The collar uses rubber or a similarly compliant material to conform to the cylinder shoulder/dome area. This prevents precession (slippage) so it holds location and minimizes vibration when the cylinder rotates. The domes on the cylinders are formed by forcing the heated cylinder cup into a die, and spinning the cylinder. By clamping on the dome area, the cylinder is centered, as manufactured. By minimizing the vibration in this way, the cylinder can be spun faster than prior art methods, resulting in faster scans. The rubber collar also keeps the metal cap from contacting the cylinder, and thus possibly damaging the cylinder. The cap is attached through a keyway to the drive motor. In an alternate embodiment, the cap can be coupled to the drive train through a drive cone (e.g., a rubber cone that mates with the cap and the drive train). However, if the cap is attached to the drive train via a keyway, the cylinder can be spun more rapidly; accordingly, this embodiment is preferred. In either case, the cap fits over the cylinder valve and can be adapted with simple slots to handle a wide variety of valves including those on fire extinguishers. Thus, valves do not need to be removed.

The tank is specially designed to accommodate a range of cylinders from the largest to the smallest in typical commercial use. This is accomplished by allowing the tailstock, e.g., as set forth in **Figure 1**, to be able to slide along a guide, and then be locked in place. For cylinders that are

longer or shorter, the tailstock can be moved farther from or closer to the cap, accommodating the various cylinder lengths. The movement of the tailstock can be performed manually, or can be automated with pneumatic, hydraulic or servo-mechanical methods.

The normal thickness scan is done on an axis perpendicular to the surface, e.g., as shown in **Figure 4**.

To create the correct angle for the circumferential scans, the circular nature of the cylinder is taken advantage of. This angle can be calculated from first principles, using Snell's Law of refraction, as is well known in the physics literature. The transducer is moved above the cylinder centerline axis until the correct angle to the normal is achieved, whereby a 45-degree angle beam shear wave is created in the cylinder wall, as shown, e.g., in **Figure 5**. To get the opposite circumferential direction the transducer is lowered to a similar position below the cylinder centerline axis. The two longitudinal scans are accomplished using a specially designed search tube holder, e.g., as shown in **Figure 6**, that is rotated to a precise angle. This can be performed either manually or automated by attaching a motor to the search tube holder. This fixture holds the transducer at the correct angle to create a 45-degree angle beam shear wave scan as the transducer is translated down the length of the cylinder to detect flaws such as pits and cracks.

A simplified and much less expensive scanner than previously available was built and tested to confirm that the single sensor/multiple scan approach would work. Software was written to automate the scanning. All of the A-scan data (the raw signals from the sensor) were captured digitally, and saved to an electronic media for analysis. In this case, the data was stored in computer memory, and then analyzed. It can, of course, be stored to a hard drive, CD, etc. and then analyzed. All defects were easily mapped and displayed for a user on a computer screen.

Typically, system software provides motion control, data acquisition and data analysis. This eliminates much of the complex hardware required to coordinate the motion of the various axes during the scan. That is, many prior art systems use analog electronics to analyze the data. This leaves only a few signal parameters to describe the transient A-scan signal received by the sensor, and the signal cannot be reanalyzed. If there is noise in the signal (e.g., electromagnetic interference) in the analog system, it can be interpreted incorrectly, resulting in false defect detection. By using high-speed A/D boards and acquiring the digital representation of the signal from the sensor, the signal can be re-analyzed, eliminating these false calls. It also reduces expensive analog circuitry, since the analysis is performed in software. Modifications can be made quickly to the software analysis, as opposed to redesigning and manufacturing new analog circuits.

A flow chart of typical software functions is shown in **Figure 7**. The data for the cylinder to be tested (diameter, length, wall thickness, material) and scanning parameters (A/D digitization rate, window length, pulses per revolution, rotational speed, helix index, etc) is input into a job that can be recalled. The user selects the appropriate job for the cylinder to be retested and begins the scan. The software monitors the encoder output from the rotary motor and triggers the pulser/receiver to send a pulse to the sensor at the appropriate time, as determined by the scanning parameters. The software then controls the data acquisition board, and stores the digitized data to an electronic format, suitable for recall of the data. Data analysis routines in the software then analyze the signals for wall thickness and defects, and display the information. Software routines alert the operator to defects that exceed the minimum size criteria.

The system is also more flexible in that different container metals (or other materials) can be accommodated easily, since the changes for the various metals are input into the software, and do not require the manufacture of new hardware. Changing transducers for different frequency scans is simpler and much less costly, and maintenance is reduced significantly since only a single set of electronics for launching and receiving the ultrasonic pulse is needed. The elimination of the bulky "shoe" allows easier scanning of smaller cylinders. Unlike the flooded head systems, no water recirculation systems are needed to supply water to the heads. The small amount of water in the tank is used over and over, thus saving water. The scanner is portable, e.g., by pickup truck. This can reduce or eliminate wasteful transport of empty steel cylinders over hundreds of miles to central retest stations.

It will be appreciated that the above methods and apparatus can be modified for the use of multiple sensor arrays for the scanning of cylinders. That is, although not necessary, it is certainly possible to use more than one transducer/receiver in the system. All of the concepts noted above still apply and, of course, the apparatus for centering and rotating the containers is universally applicable, regardless of the precise transmitters or receivers which are used.--

COMMENTS ON ABOVE AMENDMENT TO THE SPCIFICATION

Please note that this amendment is made without prejudice to subsequent renewal of the specification in its original form. This amendment is made solely to expedite issuance of the application and is not to be taken as agreement with any objection or rejection of record. This amendment is purely formal in nature and introduces no new subject matter, merely rearranging application passages as directed in the *Ex Parte Quayle* Action of September 16, 2003.